Office of Operating Experience Analysis, EH-33 • U.S. Department of Energy • Washington, D.C. 20585

OPERATING EXPERIENCE WEEKLY SUMMARY

Office of Nuclear and Facility Safety

September 4 - September 10, 1998

Summary 98-36

Operating Experience Weekly Summary 98-36

September 4 through September 10, 1998

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EVENTS

1. SUBCONTRACT EMPLOYEES BURNED AT FERMI

On September 4, 1998, at Fermi National Accelerator Laboratory, a vapor flash-explosion ignited combustible material and burned three subcontractor service employees while they were cleaning a concrete floor. An area sprinkler system activated and extinguished the fire. Fire department personnel responded to the scene and sent all three employees to off-site medical facilities. Medical personnel treated two of the subcontractor service employees for first- and second-degree burns and released them. They transported the third employee by helicopter to a facility with a burn unit, where he remains hospitalized in fair condition. Laboratory personnel secured the accident area. The DOE Chicago Area Office assembled a Type B Accident Investigation Team to investigate the event. (ORPS Report CH-BA-FNAL-FERMILAB-1998-0004)

The subcontractor service employees used a floor-buffing machine to strip a floor in an enclosed office to prepare it for painting. While floor-buffing, they encountered grease stains that were difficult to remove and used acetone to remove them. One of the workers accidentally spilled a 1-gallon container of acetone and began to clean it up while another worker continued buffing the floor. When the vapors ignited, they produced the flash-explosion, burning all three employees. Investigators believe that operation of the floor-buffing machine ignited the acetone vapors. OEAF engineers will follow the accident investigation and provide information as it becomes available.

KEYWORDS: injury, Type B investigation, burn

FUNCTIONAL AREAS: Industrial Safety, Lessons Learned

2. PRESSURIZED DRUM SAFELY VENTED USING ROBOTICS

This week, OEAF engineers identified a good practice involving safe handling of pressurized drums. On September 2, 1998, at the Idaho National Engineering and Environmental Laboratory, personnel vented a pressurized waste storage drum using remote robotics. The drum contained calciner pilot plant scrub solution consisting primarily of nitric acid and non-radioactive calcine fines. Personnel discovered the deformed drum earlier in the day while conducting a routine inspection of a temporary accumulation area. Pressurized drums can present several personnel hazards, including injury from an expelled drum lid or fragments of the burst drum and exposure to radioactive or hazardous contents of the drum. (ORPS Report ID--LITC-WASTEMNGT-1998-0016)

Investigators determined that the 30-gallon polymer drum was deformed because of a build-up of nitrogen oxides resulting from the decomposition of the nitric acid in the drum. The facility manager ordered evacuation of the drum storage area and adjacent facilities and activation of the Emergency Control Center to support recovery operations. The Central Facility Fire Department and the Incident Response Team responded. Team members used a robotic device to drill a hole in the drum and relieve the pressure. The facility manager will develop corrective actions for this event as necessary.

NFS reported drum pressurization events in several Weekly Summaries. In the first of the following event summaries, inspectors identified pressurized drums and safely vented them. In the other events, the drums ruptured before anyone identified a problem with their condition.

- Weekly Summary 98-10 reported that an inspector at the Idaho National Engineering and Environmental Laboratory found two bulging drums stored in a locked Resource Conservation and Recovery Act-compliant portable storage unit. Investigators believe the effect of anaerobiosis on septic wastes stored in the drums generated gasses and pressurized the drums. Inspectors recognized the hazards presented by pressurized drums and took appropriate actions to mitigate these hazards. Inspectors monitored the drums daily until pressure was safely released. (ORPS Report ID--LITC-CFA-1998-0002)

- Weekly Summary 97-49 reported that a packager at Pacific Northwest National Laboratory heard a noise coming from a storage cell, opened the door to investigate, and discovered an acid spill. Waste management personnel determined that waste drums had overpressurized, ruptured, and spilled approximately 100 gallons of acid into sumps used for spill control. They also determined that workers mixed incompatible materials (phosphoric acid and metal), causing a chemical reaction in the drums. (ORPS Report RL--PNNL-PNNLBOPER-1997-0022)

- Weekly Summary 97-39 reported that at the Paducah Gaseous Diffusion Plant a 110-gallon over-pack drum containing a 55-gallon drum of nitric acid and a mixture of low-level radioactive waste ruptured in a Plant waste storage facility. The force of the rupture expelled the inner drum and spread its contents over a 400-square-foot area. Investigators believe nitric acid reacting with the steel drum produced the overpressurization. (ORPS Report ORO--LMES-PGDPENVRES-1997-0008)

- Weekly Summary 97-30 reported that at the Oak Ridge Y-12 Site a sealed, plastic-lined, 55-gallon drum, containing organic waste materials from the cleanup of a nitric acid spill, overpressurized and the lid blew off the drum. The force of the venting caused the lid to strike and bend an overhead fire protection system pipe and dislodge the pipe hangers. The contents of the drum were strewn about the storage area. Investigators determined that workers mixed incompatible materials (nitric acid and organics), resulting in a chemical reaction that overpressurized the drum. (ORPS Report ORO--LMES-Y12WASTE-1997-0004)

These events underscore the importance of recognizing that many of the materials typically stored in drums generate gasses and may pressurize the drum. Drum selection should take into account the possibility of gas generation and should incorporate a self-venting feature or provide for convenient manual venting if evidence of pressurization is observed. These events also underscore the importance of recognizing a pressurized drum and knowing the hazards that a pressurized drum presents to workers and the environment. In the most recent Idaho event, personnel were aware of the hazards presented by a pressurized drum and took appropriate actions to vent it. Personnel also need to be aware that new and empty drums can become pressurized. On May 17, 1995, at the Grand Junction Project Office, the lid on a new 55-gallon drum blew off when a radiation technician attempted to remove it. Investigators believed differences between ambient conditions at the location where the drum was sealed and where it was opened caused the pressurization. There was no indication of pressurization. (Lessons Learned List Server Item Number 1995-Al-GEO-01)

The following documents provide valuable guidance for all personnel who work with chemicals and hazardous materials.

- DOE/NS-0013, Safety Notice 93-01, “Fire, Explosion, and High-Pressure Hazards Associated with Waste Drums and Containers,” describes lessons learned on safe storage and handling of waste containers and drums. The notice specifically

discusses handling, storing, venting, and opening containers suspected of being pressurized or containing flammable vapors.

- DOE/EH-0557, Safety Notice 97-01, "Mixing and Storing Incompatible Chemicals," contains lessons learned related to the mixing and storing of incompatible chemicals. It also references a list of chemical incompatibilities provided by Michigan State University. (The list is available on the Internet at URL http://www.orcbs.msu.edu/chemical/chp/appendixc.html.)

- DOE/EH-0296, Bulletin 93-02, "Mixing of Incompatible Chemicals," February 1993, provides information about the hazards associated with mixing of incompatible chemicals.

- The Office of Defense Programs published two Safety Information Letters, SIL 96-05, *Compatibility Considerations in the Mixing of Waste Chemicals,* November 1996, and SIL 96-01, *Incidents from Chemical Reactions due to Lack of or Failure to Follow Proper Handling Procedures,* June 1996, that address chemical hazards and provides guidance to prevent similar incidents.

Safety Notices and Bulletins can be obtained by contacting the ES&H Information Center, (800) 473-4375, or by writing to U.S. Department of Energy, ES&H Information Center, EH-72, 19901 Germantown Road, Germantown, MD 20874. Safety Notices are also available on the Operating Experience Analysis and Feedback Home Page at http://tis.eh.doe.gov:80/web/oeaf/lessons_learned/ons/ons.html. Copies of ES&H Bulletins can also be obtained on the ES&H Documents Collection Home Page at http://www.tis.eh.doe.gov/docs/docs.html or by writing the Safety Performance Indicator Division, Office of Environment, Safety and Health, U.S. Department of Energy, Washington, DC 20585. Safety Information letters can be obtained by contacting Tom Rotella, Defense Programs, Office of Engineering, Operations, Security, and Transition Support, at (301) 903-2649 or thomas.rotella@dp.doe.gov.

KEYWORDS: chemical reaction, pressurized drum, safety, waste

FUNCTIONAL AREAS: Chemistry, Industrial Safety, Materials Handling and Storage

3. PNEUMATIC FLOW CONTROL VALVE MANUAL ACTUATOR FAILS

On September 1, 1998, at the Savannah River Vitrification Facility, a manual handwheel and stem assembly, weighing approximately 20 pounds, fell approximately 10 feet when it broke off a pneumatic flow control valve actuator during calibration operations. The assembly landed within a few feet of a maintenance worker, but no one was injured. Instrument mechanics had closed the flow control valve pneumatically while they were preparing to calibrate valve-positioning circuits, using a manual handwheel to keep the valve in the closed position. A step in the calibration procedure required them to remove an electronic signal lead. When they lifted the lead, the circuit responded to a loss-of-signal condition, introducing opening air pressure to the

flow control valve. The force generated by the operating piston destroyed the handwheel assembly. Investigators determined that maintenance personnel did not understand the intended function of the manual handwheel or the operating characteristics of the flow control valve. Inadequate knowledge of valve design and operating characteristics contributed significantly to equipment damage and created the potential for personnel injury. (ORPS Report SR--WSRC-WVIT-1998-0025)

The flow control valve is an 8-inch radial orifice valve (Ingersoll-Dresser model G55725) with a double-acting piston actuator. A spring below the operating piston opens the valve on loss of air pressure. The valve is equipped with a manual handwheel that can be used to restrict motion in the open direction. It is also equipped with a "HAND/AUTO" valve that shuts off the control air supply and equalizes pressure around the operating piston.

Investigators determined that the valve failed because it was operated improperly. The manual handwheel is intended to act against an opening spring and is not designed to restrict valve travel when control air pressure is applied. They determined that the operating piston can apply a force of up to 22,000 pounds against the manual handwheel assembly with control air pressure to its opening. However, the handwheel assembly is only capable of withstanding a force of approximately 10,000 pounds. The maximum opening force that can be applied with the "HAND/AUTO" valve in the "HAND" position is 2,000 pounds, which is exerted by the opening spring. Investigators also determined the following.

- Maintenance instructions did not address the integral "HAND/AUTO" valve.
- The operator who positioned the handwheel did not notice the "HAND/AUTO" valve, which is obscured by the body of the flow control valve.

Facility maintenance personnel should be aware that an unsafe condition is created when operators engage or partially engage handwheels on valves of this design while control air is available to the actuator. Facility managers should direct a review of facility design to determine if this type of valve is used and should ensure that maintenance and operating procedures describe proper operation of manual handwheels. Managers and supervisors in charge of job performance should ensure that work hazards are identified and properly addressed. Facility managers should also ensure that personnel understand the basics of the job hazard analysis process.

Facility managers should review DOE O 4330.4B, *Maintenance Management Program,* and should ensure that these recommendations are incorporated into worker safety programs. Chapter 6 provides guidance for preparing and using maintenance instructions and other work-related documents that provide appropriate work directions and ensure that maintenance is performed safely and efficiently. Section 6.2 states that experience has shown that deficient procedures and failure to follow procedures are major contributors to significant and undesirable events. Section 6.3.2 recommends providing clear indication of steps that could initiate an equipment trip or transient or initiate or interrupt any process action.

KEYWORDS: hazard analysis, flow control valve, air, work planning

FUNCTIONAL AREAS: Industrial Safety, Procedures, Work Planning

4. WORKERS VIOLATE CONTAMINATED AREA POSTING AT NEVADA TEST SITE

On August 26, 1998, at the Nevada Test Site, two subcontractor workers sent to check building heating, ventilation, and air conditioning system controls entered a contaminated area in violation of postings. The workers ignored warning signs and a fully dressed-out radiological control technician. A radiological worker noticed the workers and told them to stop and return to the barrier line. A radiological control technician surveyed the workers and detected no contamination. Failure to recognize and comply with radiological postings can result in the spread of contamination. (ORPS Report NVOO--BNLV-NTS-1998-0024)

Facility managers held a critique of this event. Attendees determined that subcontractors working on site often are not aware of job hazards and that site personnel are not told when subcontractors will be in the building. They also determined that there are no procedures for managing subcontractor workers on site. Facility managers are continuing to investigate this event and will develop further corrective actions as necessary.

OEAF engineers searched the ORPS database for similar occurrences at the Nevada Test Site and found seven occurrences involving violations of contaminated area postings. Investigators determined that these events were willful and negligent posting violations. A review of these occurrences showed that facility managers most frequently identified personnel error as a root cause and identified a lack of training as a contributing cause. Corrective actions for these events included ordering a safety stand-down, informing personnel about the consequences of posting violations, replacing obsolete and weathered postings, and disseminating lessons learned throughout the DOE/Nevada Operations Office community. (ORPS Reports NVOO--BNLV-MSRS-1998-0003, NVOO--BNLV-NTS-1998-0014, NVOO--BNLV-MSRS-1998-0001, NVOO--BNLV-NTS-1998-0011, NVOO--BNLV-NTS-1998-0010, NVOO--BNLV-NTS-1998-0006)

These events emphasize the importance of taking timely and effective corrective actions. DOE contractors who operate nuclear facilities and fail to implement corrective actions for identified deficiencies could be subjected to Price-Anderson civil penalties under the work processes and quality improvement provisions of 10 CFR 830.120, *Quality Assurance Requirements*. These actions include Notices of Violation and, where appropriate, non-reimbursable civil penalties. The primary consideration for determining whether DOE takes enforcement action is the actual or potential safety significance of the violation, coupled with how quickly the contractor acts to identify and correct problems.

Facility managers should review the following guidance and ensure that corrective actions are effectively implemented to reduce the recurrence of events.

- DOE-STD-7501-95, *Development of DOE Lessons Learned Programs*, discusses management responsibility for incorporating appropriate corrective actions in a timely manner.

- DOE-STD-1004-92, *Root Cause Analysis Guidance Document,* chapter 6, “Corrective Actions,” states that proposed corrective actions should be (1) reviewed to ensure the appropriate criteria are met, (2) prioritized based on importance, (3) scheduled, (4) entered into a commitment tracking system, and (5) implemented in a timely manner. It states that a complete corrective action program should be based on specific causes of the occurrence, lessons learned from other facilities, appraisals, and employee suggestions. It also states that a successful program requires management involvement at the appropriate level and willingness to take responsibility and allocate adequate resources for

corrective actions. Chapter 8, "Follow-Up," provides information on following up on corrective actions to determine if they have been effective in resolving problems. It states that corrective actions should be tracked to ensure they have been properly implemented and are functioning as intended. It also states that the recurrence of the same or similar events must be identified and analyzed and, if the same or similar event recurs, the original occurrence should be investigated to determine why corrective actions were not effective.

- DOE-STD-1010-92, *Guide to Good Practices for Incorporating Operating Experiences,* and DOE-STD-7501-95, *Development of DOE Lessons Learned Programs,* provide guidance on a systematic approach for incorporating operating experiences. The standards describe an approach for implementing the following elements into site lessons-learned programs.

    - selecting and analyzing events for facility operation
    - ensuring that event reports and subsequent analysis are distributed to appropriate organizations
    - incorporating report information into new or existing programs and training
    - tracking action plans to ensure that corrective actions are completed
    - assessing effectiveness of the changes

KEYWORDS: contamination area, barrier, posting requirement

FUNCTIONAL AREAS: Radiation Protection, Training and Qualification

OEAF FOLLOW UP ACTIVITIES

1. ELECTRICAL ARC BLAST BURNS ELECTRICIAN AT KANSAS CITY PLANT

Weekly Summary 98-21 reported that an electrician at the Kansas City Plant received second- and third-degree flash burns from an electrical arc blast while cleaning a 13.8-kV switch at an outdoor sub-station. The electrician was stunned by the arc blast and wandered in a nearby area until a maintenance team manager and two millwrights found him while investigating the cause of smoke coming from the area. A Patrol Sergeant tried to call 911, but was unable to reach an outside line, so a Patrol Lieutenant assumed responsibility and transported the electrician to a hospital using the site ambulance. During transport, the ambulance's brakes failed, no one could locate the external emergency ambulance lights, and accompanying personnel could not locate the first aid supplies. The electrician was later transferred to a hospital with a burn unit where he received skin grafts to his right arm and left hand. DOE assembled a Type B Accident Investigation Board to review this event. The Board completed the accident investigation report in July 1998. They identified the root cause of the event as lack of effective work integration and failure to responsibly implement the high-voltage work control process. The Board's report contains valuable lessons for other DOE facilities and is summarized in this article. Figure 1-

1 shows the severity of the burn marks on the electrician's safety glasses. (*Type B Accident Investigation Board Report on the May 24, 1998, Electrical Arc Blast at the Kansas City Plant*, July 1998; and ORPS Report ALO-KC-AS-KCP-1998-0010)

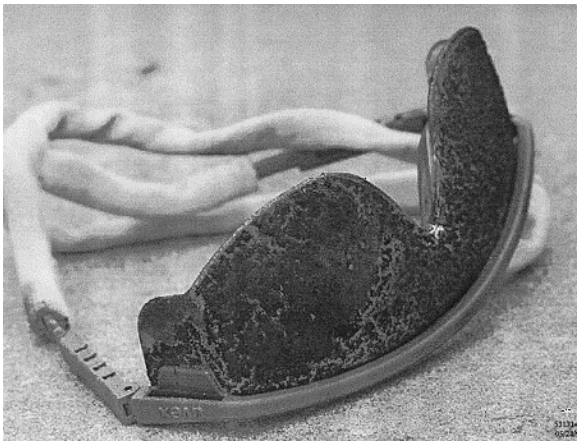

Figure 1-1. Electrician's Safety Glasses

The Accident Investigation Board determined that the electrician used a paintbrush to clean the inside of a switchgear cabinet and did not know that the surrounding equipment was energized. Although they were unable to determine the exact event scenario, the Board concluded that an electrical fault was created either by debris falling onto energized equipment or by the electrician's shirt sleeve contacting energized equipment. Following is a summary of some of the Board's conclusions.

- AlliedSignal Federal Manufacturing & Technologies/Kansas City (FM&T/KC) personnel deviated from established electrical safety procedures. These deviations included deficiencies in the following areas: (1) interdepartmental communications; (2) hazard identification processes; (3) pre-job briefing; (4) implementation and supervision of the lockout/tagout program; (5) implementation and supervision of grounding cluster installation; and (6) implementation of the electrical glove program.

- AlliedSignal FM&T/KC's feedback and improvement processes were not effective in identifying or providing feedback for high-voltage electrical procedural noncompliances.

- AlliedSignal FM&T/KC managers did not ensure that (1) emergency medical communication systems were adequate, (2) emergency responders were trained to treat personnel involved in electrical accidents, or (3) emergency transportation was adequate.

- AlliedSignal FM&T/KC managers did not ensure that the accident scene was controlled in accordance with DOE O 225.1A, *Accident Investigations,* requirements.

This event underscores the importance of using an integrated approach to safety that stresses clear goals and policies, individual and management accountability and ownership, implementation of requirements and procedures, and thorough and systematic management

oversight. The responsibility for ensuring adequate planning and control of work activities resides with line management. Managers should ensure that work control processes are followed and facility practices are enforced. Safety and health hazard analyses must be included in the work control process to help prevent worker injury. The hazard analysis process should include provisions for lockout/tagouts, job-specific walk-downs, integration of work activities, and personnel protective equipment. Pre-job briefings, facility procedures, and training programs should emphasize the dangers associated with high-voltage electrical activities.

This event also demonstrates the importance of multiple engineered barriers to prevent hazardous events such as electrical shocks or discharges. Although human performance (supported by procedures, policies, memoranda, or standing orders) is a standard barrier to preventing electrical shocks and arcs, the probability of prevention can be increased by adding physical barriers such as lockouts and tagouts.

A good lockout/tagout program is an important element of an effective conduct of operations program. Lockout/tagout programs in DOE serve two functions. The first function, defined in both 29 CFR 1910, *Occupational Safety and Health Standards*, and DOE O 5480.19, *Conduct of Operations Requirements for DOE Facilities,* is to protect personnel from injury and protect equipment from damage. The second function is to provide overall control of equipment and system status. Lockout/tagouts are typically applied during maintenance activities; however, there are many cases when lockout/tagouts are needed for personnel safety. The standard states that an effective lockout/tagout program requires three elements. These elements are as follows: (1) all affected personnel must understand the program; (2) the program must be applied uniformly in every job; and (3) the program must be respected by every worker and supervisor.

Managers and supervisors in charge of job performance should ensure that hazards are identified and corrected. DOE facility managers should ensure that personnel understand the basics of work control practices and safety and health hazard analyses. Personnel in charge of system design changes should ensure that facility documentation, including drawings, is updated and accurate. Many references apply to this event. Following are some examples that facility managers should review to ensure they are incorporated in current facility safety programs.

- DOE O 4330.4B, *Maintenance Management Program,* chapter 6, provides guidance for preparing and using procedures and other work-related documents that contain appropriate work directions. Section 6.2 states that experience has shown that deficient procedures and failure to follow procedures are major contributors to many significant and undesirable events.

- 29 CFR 1910.333, *Selection and Use of Work Practices*, states: “when any employee is exposed to contact with parts of fixed electric equipment or circuits which have been de-energized, the circuits energizing the parts shall be locked out or tagged out.” It also states: “safety-related work practices shall be employed to prevent electric shock or other injuries resulting from either direct or indirect electrical contacts, when work is performed near or on equipment or circuits which are or may be energized.” It also requires a qualified person to test the equipment to verify that all circuit elements and equipment parts are de-energized.

- DOE-STD-1030-96, *Guide to Good Practices for Lockouts and Tagouts*, section 1, “Introduction,“ states that the primary purpose of lockout/tagout programs is to protect employees from exposure to potential hazardous energy sources. This standard also states that lockout/tagout programs promote safe and efficient operations and are an important element of conduct of operations programs.

- DOE-STD-1073-93-Pt.1 and -Pt.2*, Guide for Operational Configuration Management Programs, Including the Adjunct Programs of Design Reconstitution*

and Material Condition and Aging Management, provides guidelines and good practices for an operational configuration management program including change control and document control.

- DOE-STD-1120-98, *Integration of Environment, Safety, and Health into Facility Disposition Activities*, provides guidance for enhancing worker, public, and environmental safety. This standard supports integrated safety management system principles to guide the safe accomplishment of work activities, which include: (1) line management responsibility for safety; (2) clear roles and responsibilities; (3) competence commensurate with responsibilities; (4) balanced priorities; (5) identification of safety standards and requirements; (6) hazard controls tailored to work being performed; and (7) operations authorization.

- DOE/EH-0540, Safety Notice No. 96-05, "Lockout/Tagout Programs," summarizes lockout/tagout events at DOE facilities, provides lessons learned and recommended practices, and identifies lockout/tagout program requirements.

- The *Hazard and Barrier Analysis Guide*, developed by OEAF, discusses barriers that provide controls over hazards associated with a job. Barriers may be physical barriers, procedural or administrative barriers, or human action. The reliability of barriers is important in preventing undesirable events such as shocks. The reliability of a barrier is determined by its ability to resist failure. Barriers can be imposed in parallel to provide defense-in-depth and to increase the margin of safety. The *Hazard and Barrier Analysis Guide* provides a detailed analysis for selecting optimum barriers, including a matrix that displays the effectiveness of different barriers in protecting against some common hazards.

Accident investigation reports are available on the Internet at URL http://tis.eh.doe.gov/web/eh2/acc_inv.html. DOE technical standards are available on the Internet at URL http://www.doe.gov/html/techstds/techstds.html. OSHA regulations are available on the OSHA Home Page at URL http://www.osha-slc.gov/OshStd_data. Safety Notice 96-05 can be obtained by contacting the ES&H Information Center, (800) 473-4375, or by writing to U.S. Department of Energy, ES&H Information Center, EH-72, 19901 Germantown Road, Germantown, MD 20874. Safety Notices are also available on the OEAF Home Page at URL http://tis.eh.doe.gov:80/web/oeaf/lessons_learned/ons/ons.html. A copy of the *Hazard and Barrier Analysis Guide* is available from the ES&H Information Center, or on the Internet at URL http://tis.eh.doe.gov:80/web/oeaf/tools/hazbar.pdf.

KEYWORDS: electrical, work control, injury

FUNCTIONAL AREAS: Industrial Safety, Configuration Management, Hazards Analysis, Work Control

2. PUMP CASING RUPTURE AT OAK RIDGE

This week OEAF engineers reviewed a Type C investigation report about a pump casing rupture at the Oak Ridge Y-12 Chiller Building. On August 5, 1998, the casing on a large, single-stage centrifugal pump failed catastrophically, projecting debris throughout an operating area and causing extensive damage to nearby equipment and structures. An operator received superficial cuts on the face and upper chest when pump debris struck and shattered a heavy glass window in an enclosed control area. This occurrence was a very serious near miss, as anyone in the

unprotected area near the pump could have been seriously or fatally injured. (ORPS Report ORO--LMES-Y12SITE-1998-0039 and OEWS 98-33)

Facility managers ordered a Type C investigation of this occurrence. Investigators determined that the direct cause of the failure was operating the pump with both the suction and discharge manual isolation valves closed. They determined that as much as 50 percent of motor horsepower could have been expended in raising the energy of pump contents, increasing internal pressure to as high as 3,000 psi over the 2-hour period the pump ran in the isolated condition. They also determined that pump contents flashed to steam when the casing ruptured, causing explosive destruction. The blast moved the pump motor 8 feet from its foundation, displaced an adjacent pump motor by 2 inches, and completely shattered the glass window of an operating enclosure.

Figure 2-1 shows the portion of the pump remaining on its bedplate. Figure 2-2 is a view of the general area surrounding the pump showing the extent of destruction and debris scattering. The window of the operating enclosure is at the top left of the photograph.

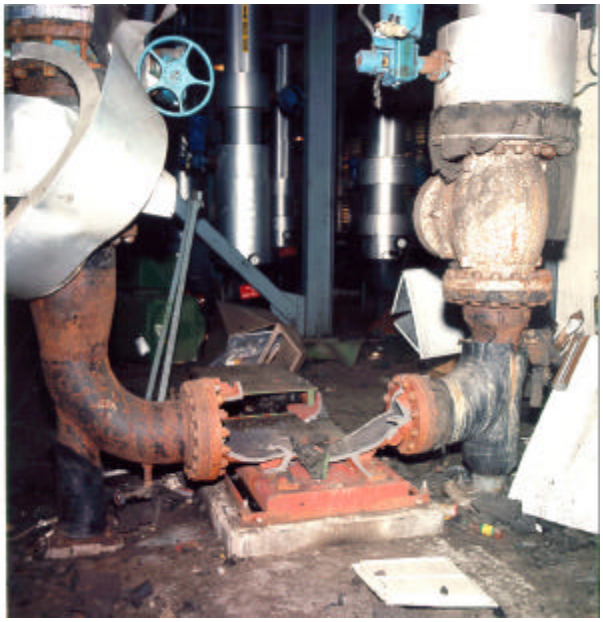

Figure 2-1. Pump Bedplate

Figure 2-2. General Area

Figure 2-3 shows an inside view of the operating enclosure.

Figure 2-3. Operating Enclosure

Investigators also identified the following contributing causes, all of which are related to conduct of operations.

- Facility managers did not implement conduct of operations guidelines for the building. Limited resources resulted in delays in a phased approach to implementation for Y-12 utilities organizations and facilities.

- Facility managers did not maintain adequate operating procedures. They cancelled procedures for building operations because they were not accurate and did not meet current guidance, but did not ensure that replacement procedures for the brine system were developed.

- Facility operators did not consistently implement detailed standing orders for building rounds and inspections. As a result, they were not completely and continuously aware of facility equipment and system status.

- Facility personnel did not complete planned maintenance in a timely manner, and maintenance activities were inadequate. Facility personnel placed the brine pump and motor in a maintenance status in 1997 because of earlier vibration problems, and maintenance was deferred because of low priority. They had placed deficient material tags on both the pump and motor, but had not issued a formal lockout.

- Facility operators did not maintain adequate equipment status information. A status board showed that the pump was in a maintenance status when it failed. It also showed inconsistent alignments for pumps ready for service, one of which investigators determined was completely isolated. Operators expressed low confidence in information provided by status boards.

- Building operators did not consistently follow professional operating practices. The operator who started the pump did not check its alignment or monitor operation after startup. A second operator did not notice that flow through operating chillers was less than would be expected if the pump were operating normally.

- Operators did not conduct an adequate shift turnover. An operator started the pump at 2:30 p.m. as part of a test following chiller maintenance. When shift change occurred at 3:00 p.m., the operator assuming duty did not receive a direct turnover from the off-going operator and did not notice that the pump was running. The pump failed at approximately 4:30 p.m.

- Utility operators received inadequate training. Training and retraining programs for utility operators lacked repetition and hands-on practice.

This event underscores the need to apply Conduct of Operations principles and guidelines to all phases of shift operations. DOE O 5480.19, “Conduct of Operations,” requires operations at DOE facilities to be conducted in a manner that ensures an acceptable level of safety. The Order requires a graded approach to implementation of Conduct of Operations guidelines consistent with each facility’s programmatic importance and potential environment, safety, or health impact. Site managers assigned Y-12 utilities a low priority based on programmatic criteria, but underestimated the potential for human hazard. Facility managers who oversee shift operations should review their policies and procedures to ensure incorporation of appropriate Conduct of Operations requirements and recommendations, giving particular attention to the following chapters.

- Chapter II, “Shift Routines and Operating Practices,” describes professional watch-standing practices for all operating personnel.

- Chapter VIII, “Control of Equipment and System Status,” describes methods to ensure that facility equipment and systems are maintained in accordance with the design basis authorization and that facility personnel are aware of their status. The Order states that before placing systems or equipment into operation, operating personnel should ensure that they are properly aligned.

- Chapter XI, “Logkeeping,” provides guidelines on establishing operating logs, recording information, ensuring legibility of entries, and performing reviews of logs. Logs are a valuable tool for transferring information among operating personnel.

- Chapter XII, “Operations Turnover,” states that shift turnover is a critical part of DOE facility operations. The Order also states that on-coming personnel should not assume operational duties until both they and the off-going personnel have a high degree of confidence that an appropriate information transfer has taken place. On-coming personnel should conduct a comprehensive review of appropriate written information (logs, records) and visual information (equipment, controls, status boards) before responsibility for the shift is transferred. Shift turnovers should be guided by a checklist and should include a facility walk-down and a thorough review of documents describing facility status.

- Chapter XVI, “Operations Procedures,” states that operations procedures should provide direction to ensure that the facility is operated safely and within its design basis. Developers should give attention to writing, reviewing, and monitoring operations procedures to ensure that content is technically correct and the wording and format are clear. Facility operators should develop procedures for all anticipated operations or evolutions.

KEYWORDS: pump, injury, conduct of operations, damage, explosion

FUNCTIONAL AREAS: Conduct of Operations, Procedures, Training and Qualification